Energy Policy ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Efficient lighting in buildings: The lack of legislation in Portugal

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HIGHLIGHTS

- In the Portuguese legislation there are no rules concerning the use of daylight.
- Lack of specific regulation limiting power density of artificial lighting.
- Revision of Portuguese building energy systems regulation.
- Some proposals for future legislation.
- Improvement of Portuguese buildings promoting energy efficiency.

ARTICLE INFO

Article history:
Received 31 December 2012
Received in revised form
21 September 2013
Accepted 8 November 2013

Keywords:
Energy efficiency in buildings
Legislation and regulations
Lighting
Daylighting
Design of buildings and technical building systems

ABSTRACT

The behavior of building designers is conditioned by the existing legislation and regulations in the national context in which they operate. However, in the Portuguese legislation there are no rules concerning the use of daylight, and therefore, designers are not stimulated to adopt solutions that make use of the existing potential of sunlight availability. In the same way, it is difficult to understand the lack of specific regulation, with quantified targets, limiting power density of artificial lighting installed inside buildings. The present opportunity, generated by the need to carry out the revision of Portuguese building energy systems regulation, should be used to fill the existing gap in national legislation regarding those matters. In this paper the authors present some proposals for future legislation that will have as central purpose the utilization of efficient lighting systems and the promotion of architectural solutions that optimize the use of daylighting. It is possible, and desirable, to add new directives to national legislation that contribute to the improvement of Portuguese buildings, characterized by its good performance in terms of daylight availability, and at the same time, increasing the energy efficiency and reducing the energy consumption of lighting systems installed in those buildings.

1. Introduction

One of the sectors with higher preponderance on Portuguese energy consumption is the building sector, both in its residential and commercial components, as can be seen in the statistics of energy consumption published over past years. This is the case of the year 2009, more recent consolidated data, where energy consumption in buildings is 30% of total national consumption in final energy (DGEG, 2010) and approximately 60% of national electricity consumption (INE, 2011). A substantial portion of that energy consumption is electrical energy used to generate artificial lighting in commercial buildings. With this present concern, and to illustrate numerically the significance of lighting in energy consumption, it was possible to find a value for the rate of lighting energy consumption in the total electricity consumption of commercial buildings from the data published in the synthesis report "Caracterização Energética do Sector de Serviços" (DGE, 1994). Thus, energy consumption for lighting could be estimated at 29% of the total electricity consumption in commercial buildings for the year 1991. We present this value, although with reluctance for its antiquity, for the purpose of illustration of the difficulty in making an informed characterization with more recent data as it should be. The 29% figure is in line with the statistics for the nearby country of Spain that shows that for the year of 2010, 31.4% of electricity was consumed in lighting in commercial buildings (IDEA, 2011). Despite this difficulty, one can say without hesitation that lighting is one major consumer of electricity when analyzing energy consumption in the buildings sector. With reference to the above data, we can see the relevance of energy consumption of lighting and thus the available potential for

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0301-4215/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.enpol.2013.11.031

energy savings. It is possible and desirable to add, in the new Portuguese law, directives that contribute to the improvement of buildings that are constructed in Portugal, characterized by its good performance in terms of availability of daylight, and at the same time, increasing the energy efficiency of lighting systems installed in those buildings.

2. Reference of the EU

Reducing levels of consumption for lighting in the building sector should be a concern for legislators taking them to put into law the necessary regulations to encourage the best available quality design, and construction, of residential and commercial buildings so they can make better use of daylight without forgetting or harming the thermal characteristics of those buildings. This concern is in consonance with what was defined as purpose and objective in various plans and programs produced and published based on decisions of legislators at both the national and EU level. All this changing environment arises mainly from the need to comply with the EU directive on the energy performance of buildings (Energy Performance of Buildings Directive – EPBD), both in its original version of 2002 and in the reformulation of 2010. The EPBD, the buildings directive 2010/31/UE of May 19 of 2010, stipulates in its Article 1 the application of minimum requirements for the energy performance of technical building systems, when installed for the first time or when those are replaced or improved. Likewise integrates in its Article 2, in an explicit manner, the technical equipment for lighting as a component of the "technical building system" and also determines that the consumption on lighting have to be present in the calculation or measurements of the energy needed to satisfy the total demand, in order to evaluate the energy performance of that building. In its Annex I, relating to the methodology for the calculation of energy performance of buildings, the need to include in this methodology the lighting installation (mainly in the non-residential buildings) is referred. Annex I also establishes that "The methodology shall be laid down taking into consideration at least the following aspects: (…); (f) the design, positioning and orientation of the building, (…); (g) passive solar systems (…)" and "The positive influence of the following aspects shall, wherever relevant in the calculation, be taken into account: (…); (d) natural lighting (…)" (EPBD, 2010). Thus, the EPBD is a valuable ally for those who understand how important is the integration in the national legislation of regulatory provisions that have in mind the relevance of energy consumption from lighting systems and promotes its reduction by application of project practices in line with knowledge about energy efficiency in buildings. Also the use of daylighting due to integration at the design stage of the building of architectural solutions that promote the use of natural light should be encouraged, always in conjunction with the thermal part of the project to avoid unwanted heat gains.

3. Portuguese legislation and European standards

As can be seen by the EPBD, the characteristics of positioning, orientation and construction of buildings are very important for its energy performance, and for this reason a field of action that the legislators should not forget. However, daylighting is almost non-existing in Portuguese legislation. It shows a nearly complete regulatory uncertainty about the design and construction of buildings with the purpose of maximizing the use of daylight, and at the same time, increasing the visual comfort of the occupants. Take the case of the latest legislation, published in April of 2006, on the issue of energy consumption in buildings. In all these regulations you cannot find a concrete determination for the promotion of daylighting. This is also the case in the Law no. 79/2006 approving the "Regulation of Energy Systems for Buildings Acclimatization – RSECE", although its Article 1 establishes "The observance of the principles of rational use of energy and the use of materials and suitable technologies in all building energy systems, in the perspective of environmental sustainability" actually about lighting there is no reference to a single quantified measure for limiting the energy consumption (RSECE, 2006). The regulatory legislation for buildings of 2006 does not promote the decrease for the consumption needs in lighting, neither promotes the use of daylight or gives precise guidance on the use of efficient lighting systems. This difficulty in finding references to lighting in legislation is not a recent phenomenon. Already in Law no. 38382/1951 about the "General Regulation of Urban Construction – RGEU", and following revisions, the promotion of daylighting is reduced to good intentions. In that law, the only specific measure that encourages the use of daylight is a minimum for the ratio of window area per pavement area (WFR – Window to Floor Ratio). In Article 71 of that law, the design of openings to the outside with a WFR at least 10% is mandatory in most areas except for lobbies, toilets, storage and small corridors, (RGEU, 1951). This WFR value is very low and can lead to a very poor implementation of daylighting (Littlefair, 1999). It is easy to conclude for the low ambition established in RGEU for the efficient use of daylight in Portuguese buildings.

Concerning to artificial lighting, the will to reduce their energy consumption, regarding the lighting power density – LPD – installed, manifests in reality with processes of intentions and recommendations with lack of ambition. It is known that the limitation of power density is a key element to achieve the reduction of energy consumption for lighting; however it is very difficult to find a regulatory reference with quantified objectives for that quantity at the national level. The most relevant references on energy efficiency can be found in the "Portuguese National Action Plan for Energy Efficiency – PNAEE" and in the European standard "EN15193: Energy performance of buildings – Energy requirements for lighting". The European standard, because it is of compulsory publication in Portugal, here is associated with the Portuguese law. Considering the first case, the PNAEE, published as law in May 2008 by the Resolution no. 80/2008 which aims to, through an aggregator plan, establish energy efficiency measures in various sectors, in his Program no. 5 on energy efficiency systems in buildings, for the special case of commercial buildings, the objective of achieving "Regulations on lighting with a maximum of W/m^2 according to the uses" (PNAEE, 2008) with no reference to any measure or directive where we can envisage activities that will lead to that objective. Secondly, regarding the European standard EN15193, published in September 2007 and of mandatory adoption also in Portugal, the main objective is to define specifications for the calculation methodology for assessing the quantity of energy consumed on lighting inside buildings (EN15193, 2007). This standard also presents some schemes of reference for the objectives to be achieved on lighting energy consumption by setting references of good practices on lighting design, where it highlights the quantification of targets for the power density installed due to lighting equipment in relation to specific types of buildings. The values presented, for information purposes and not mandatory, have the particularity to their lack of ambition since, for the most part, they could easily be achieved through the installation of lighting systems based on conventional technologies, recognized for their poor performance and characterized by its energy inefficiency. One of the most interesting elements presented in EN15193 is the use of control factors in the calculation of the energy consumption per unit area for a year (kWh/m^2/year). This calculation is based on an indicator called "Lighting Energy Numeric Indicator – LENI", which affects the LPD installed with a set of control factors that cause the reduction of

Please cite this article as: Almeida, A.M., Martins, A.G., Efficient lighting in buildings: The lack of legislation in Portugal. Energy Policy (2014), http://dx.doi.org/10.1016/j.enpol.2013.11.031